Rick Hance

Engineering Note

Date: 12/26/01
Rev Date:

Project: EED Infrastructure Group
Doc. No: H011226A-Hance-EED_Infrastructure_Group_Operations

Subject: EED Infrastructure Group Operations

Contents

1. Assignment of Tasks

Infrastructure Group members may be approached by anyone to perform work. Our intention is to be accessible and useful to the Laboratory, Electrical Engineering Department, and experiment collaborators. However we must manage our resources efficiently. Use your judgment. All new or unusual tasks requiring a significant diversion from work in progress, or a commitment for a significant amount of time and resources must be cleared with the Group Leader before commencing. Group members may directly discuss requests with the Group Leader or may refer the requestor to the Group Leader for clearance to proceed.

2. Effort Reports

ALL Infrastructure Group and Sub-Group members must record the time they spend working on projects for other groups or collaborators. All such time must be charged to the appropriate project. The Group Leader will ask each month for an accounting in order to prepare an Effort Report. For monthly persons, this will be the number of DAYS spent working on each project (rounded up to the nearest 1/2 day). For weekly persons, this will be the number of HOURS spent working on each project (rounded up to the nearest 4 hours).

3. Documentation Control

All systems and circuits must be documented well enough that they can be reviewed, developed, and maintained. Up-to-date documentation must be on file for each of our projects. Our documentation control procedures are simple. They consist of assigning a reference number, preparing the document, filing it in an "accessible place", and posting changes as they occur.

The group will utilize a Particle Physics Division (PPD) file server as a central "accessible place" to maintain working "**Computer Files**". The group will also maintain a web site on the file server where appropriate pdf files will be deposited for access via the world wide web. The Group Leader or his designee will maintain the file structure and the web site. The Group Leader or his designee will also maintain "**Hardcopy Files**" in notebooks of relevant information.

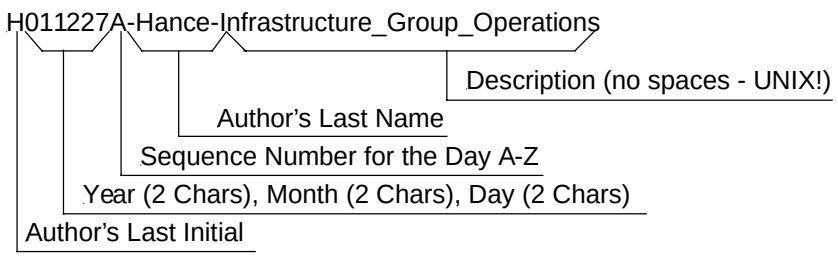
There are three types of documents as described below:

3.1. Engineering Notes

All work that generates or compiles useful knowledge should be documented in Engineering Notes. Most Engineering Notes will be relatively informal and will be kept in the individual's files. Individuals should use basic computer tools to keep track of those Notes. In addition to "informal" Engineering Notes, those notes that comprise the "formal" documents of Infrastructure Group Projects should be kept in the "**Computer Files**" on the PPD file server and in the "**Hardcopy Files**" in the Group Leader's office. In both places, they will be accessible to all members of the Infrastructure Group. Some Engineering Notes will also become pdf files available on the web site.

Formal Engineering Notes should contain any information that will not be found on a schematic. This might include design specs, user information, simple wiring diagrams, written programmable logic device (PLD) descriptions, bills of material, and lists of all related documentation such as Engineering Notes, drawings, and software files.

A Microsoft Word template will be used to provide a standard header format[1]. In the interest of encouraging the use of Engineering Notes by simplifying the process, each person will assign his own Engineering Note numbers. The numbering format as shown below works for WINDOWS and UNIX systems, forces the documents to be automatically sorted in chronological order, and provides for easy locating by any search mechanism. The format is described in the following example:



3.2. Drawings

Schematic diagrams that will result in printed circuit boards (PCBs) will be drawn using VERIBEST schematic entry software so that the PCBs can be designed by the "EED/CAD Sub-Group". Other schematics and mechanical drawings may be hand drawn, or drawn on any computer automated engineering (CAE) platform. Regardless of how they are drawn, "**Computer Files**" must be kept on the file server and up-to-date, B-size hardcopies must be kept in the Group's "**Hardcopy Files**" in the Group Leader's office. Proper Fermilab drawing numbers will be assigned to formal drawings. To get a drawing number, contact Rick Hance personally, by phone at X3898; or by EMAIL at HANCE@FNAL.GOV. Rick will maintain the drawing number data base until a self-service system is established.

Schematics requiring more than one page shall be done in a hierarchical format. That is, a top level drawing is made which is a detailed block diagram of the design showing all blocks and all connections between blocks. Then individual pages are made for each block. Once the technique of hierarchical drawing is understood, drawings for systems of any size can be made clear and easy to understand. Contact Rick Hance for examples of hierarchical drawings. Below are the requirements for schematics:

- Make all drawings B size. B size paper can be accordion folded, punched, and kept in a notebook with the rest of the documentation for a design. If B size is just too small - even for hierarchical drawings, then use D size. D size can be plotted to 50% scale (B size paper) and still remain readable. "A" size drawings should be incorporated into Engineering notes. Do not make C or E size drawings.
- All INPUTS to sheets, blocks, and medium and large scale integrated circuits, shall be drawn on the left and/or top. All OUTPUTS shall be drawn on the right and/or bottom. Small scale integrated circuits used as "glue logic" however, may be oriented in any direction without confusing a drawing. Bi-directional signals may be oriented "conveniently" unless the connection specifically functions as inputs or outputs.
- Use ANSI or IEEE standard symbols.

3.3. Software & Firmware

The term "software & firmware" includes programmable logic device (PLD) source files, Gerber photophot files for printed circuit boards, computer test programs and etc. Each individual is responsible for maintaining the latest versions of these files in the appropriate directory in the Infrastructure Group's "**Computer Files**" on the file server. The Engineering Note for a project or design should contain a list of all such files and where they can be found.

4. Engineering Reviews

Engineering reviews are a necessary tool in the design process. An individual should welcome the opportunity to present his design for review by his peers. Reviews are conducted "formally" or "informally" by the Group Leader and/or other persons as appropriate. The purpose of the review is to ensure compliance with project requirements; and to improve quality by fostering a free exchange of ideas, techniques and procedures, and giving each individual the benefit of the knowledge and experiences of the others.

The individual should notify the Group Leader when he is ready for a review. The Group Leader will help decide the extent and format of the review. Some reviews may be conducted "informally" and entirely on-line.

If a "formal" review is appropriate, the Group Leader will help to schedule a date and decide who should participate. The individual will make documentation available to each participant well before the review. Thus each participant will have an opportunity to familiarize himself with the work. For "formal" reviews, the individual may make a presentation to whatever depth is necessary given the complexity of the design; and the participants will discuss the various design issues. After the review, the individual and Group Leader should discuss the results including the incorporation of any suggestions rendered by the participants. It is typical to hold two reviews which are as follows:

4.1. Conceptual Design Review

This is the most important phase of a project. This review is performed before formal detail design work begins. The individual describes the problem as he understands it and the plan he has for solving it. This will usually be expressed in the form of the first Engineering Note of the project. By reviewing at this point, all parties will have a clear understanding of what is expected to be accomplished and the individual can begin detailed design with a minimum of wasted effort. This review will inevitably require several iterations by EMAIL/telephone/meetings etc before a consensus is reached and actual design work begins.

4.2. Final Design Review

This review is performed once the design is completed or nearly completed. The individual describes exactly how he has solved the problem. This review may be done before or after a prototype is built - depending on the situation. The Group Leader and the individual can decide at what point this review should be done. This review may be quite detailed. The individual should be prepared to discuss the design - even to the level of PLD equations. This review may take more than one actual session. PC boards should not be made until this review is completed.

5. Obtaining Supplies & Services

Individuals will often require supplies and services that are not available within the resources of the group. Then he/she will have to procure them either from the stockroom or by requisition from outside the lab.

5.1. Procurement

The Infrastructure Group has a "Procurement Specialist[2]" to assist with these efforts as necessary. This specialist can arrange for outside services such as Printed Circuit Board production and assembly as well as procuring production quantities of parts. Group members should communicate directly with the Procurement Specialist. The Procurement Specialist may be consulted regarding preparation and routing of purchase requests. Different projects will have different requirements and routing.

5.2. Fabrication and Assembly

The Infrastructure Group has a "Fabrication and Assembly Sub-Group[3]" to assist with these efforts as necessary. This group can fabricate and assemble nearly any electro-mechanical or electronic apparatus, or cable assemblies. They have the skills and equipment to do most work including such diverse procedures as shearing, bending, drilling and punching metal, constructing prototype apparatus from schematics, and assembling or reworking prototype quantities of through-hole or surface mount technology devices.

This group can work from drawings, or samples. Group members should communicate directly with the "Fabrication and Assembly Sub-Group".

5.3. Budget Codes

The Electrical Engineering Department provides funding for tools, training, and basic supplies. However, supplies and services related to projects are paid for from various budget codes supplied by the project's managers. There are budget codes for each major project. The Infrastructure Group Leader will provide budget codes and the name of persons who are authorized to sign for purchases.

5.4. Printed Circuit Board Design

Printed circuit boards (PCBs) are to be designed by the "EED/CAD Sub-Group[4]" PCB designers in cooperation with the schematic designer. Infrastructure Group Engineers and Techs will NOT design their own PCBs. Engineers will design circuits destined for PCBs using VERIBEST schematic entry tools. They may also direct the placement of parts on PCBs and define special requirements such as power and ground layers, minimum trace widths, critical signal paths etc. The "EED/CAD Sub-Group" will design PCBs in accordance with best practice and industry standards, and will prepare them for procurement. PCBs may then be procured by the Engineer, the "EED/CAD Sub-Group", or the "Procurement Specialist", whichever is most convenient. Individuals should avoid the situation where they turn a schematic design over to an experimenter/collaborator/outside agency for PCB design and device production because design coherency (shape selection and forward & backward annotation) and quality control is difficult and may result in poor quality products.

Outside agencies may however be used to procure parts and/or assemble and test PCBs once the production prototypes have been built and evaluated and debugged for production. Once again, the Infrastructure Group "Procurement Specialist" and "Fabrication and Assembly Sub-Group" are available to assist with these efforts.

---

[1] Microsoft Word Template for Engineering Notes is available from Rick Hance

[2] Procurement Specialist - Johnny Green

[3] Fabrication and Assembly Sub-Group Leader - Bob Jones

[4] EED/CAD Sub-Group Leader - Tom Wesson